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This consistency is established by the vanishing of the determinant

$$\Delta \equiv \begin{vmatrix} m(n-1) & q(r-1) & mq(n-r) \\ n(m-1) & r(q-1) & nr(m-q) \\ mn-1 & qr-1 & mn-qr \end{vmatrix};$$

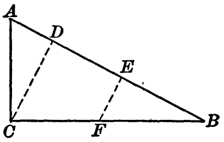
which proves the proposition.

Note.—Solutions of this problem appeared in the January and May numbers of the MONTHLY, presenting two different methods of attack. The one here given presents still a different method.

EDITORS.

459. Proposed by C. N. SCHMALL, New York City.

In a right triangle ABC, right-angled at C, a point F is taken in the side CB, and perpendiculars CD and FE are dropped on the hypothenuse AB.



Prove that

$$AD \cdot AE + CD \cdot EF = \overline{AC}^2.$$

SOLUTION BY HERBERT N. CARLETON, West Newbury, Mass.

Triangles ACD, CDB, EFB, and ACB are similar. Hence,

$$AD : CD = EF : EB;$$

whence

$$AD \cdot EB = CD \cdot EF.$$

Similarly

$$AD : AC = AC : AB;$$

whence

$$\overline{AC}^2 = AB \cdot AD = (AE + EB)AD = AD \cdot AE + AD \cdot EB.$$

Substituting for $AD \cdot EB$, we have

$$\overline{AC}^2 = AD \cdot AE + CD \cdot EF.$$

Also solved by A. M. HARDING, J. W. CLAWSON, ELMER SCHUYLER, FRANK IRWIN, WALTER C. EELLS, L. G. WELD, J. A. CAPARO, A. H. HOLMES, NATHAN ALTSHILLER, G. W. HARTWELL, HORACE OLSON, and HARMON ANNING.

460. Proposed by J. W. CLAWSON, Ursinus College, Pa.

ABC is a triangle, O and I the centers of the circum- and in-circles respectively, and I', I'', I''' the centers of the three escribed circles. If AO, BO, CO meet the circumcircle in P, P', P'' respectively, and PR, $P'R'$, $P''R''$ are drawn parallel respectively to AI, BI, CI to meet BC, CA, AB respectively in R, R', R'', prove that: (1) PR, $P'R'$, $P''R''$ are concurrent, say at J. (2) $JO = OI$. (3) JI', JI'', JI''' are perpendicular respectively to BC, CA, AB. (4) AR, BR', CR'' are concurrent.

I. SOLUTION BY THE PROPOSER.

(1) Extend IO its own length to J. Join JP. Then $\triangle$'s AOI, POJ are congruent. Hence, $\angle APJ = \angle PAI$. Hence J lies on PR. Similarly, J can be shown to lie on $P'R'$ and on $P''R''$.